Detailed CCN Spectra

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When all channels of the DRI cloud condensaation nuclei (CCN) spectrometers are plotted bimodal distributions are often apparent (Fig) and simultaneous direct aerosol measurements (i.e., differential mobility analyzer, DMA) show identical shapes. Hoppel minima between the modes have been used to estimate cloud supersaturations (S) but for a DMA this requires particle composition assumptions (usually ammonium sulfate) that are not needed with CCN spectra. Simultaneous DMA spectra can be transposed from size to S (critical S, S_c) by applying particle solubility in terms of kappa. The kappa value that provides a compatible overlay (Fig) reveals CCN solubility, which depends on compositiion; e.g. 1.28 for NaCl, 0.61 for ammonium sulfate, lower values for organics. Typical lower S inferred from Hoppel minima than from direct comparisons of CCN spectra with cloud droplet concentrations can reveal important cloud physics; i.e., smaller droplets may not participate in cloud processes that produce Hoppel minima. Cloud S identifies the atmospheric particles that produce cloud droplets and thus which particles produce the indirect aerosol effect, which is the largest climate uncertainty. Detailed CCN spectra also provide better correlations with droplet concentrations when multiple regression analysis is used, which can also reveal the relative importance of vertical velocity versus CCN for determining droplet microphysics. Detailed CCN spectra also provide better inputs for model predictions of droplet spectra to compare with measured droplet spectra. Data from numerous aircraft field projects around the world are analyzed with these new techniquies.

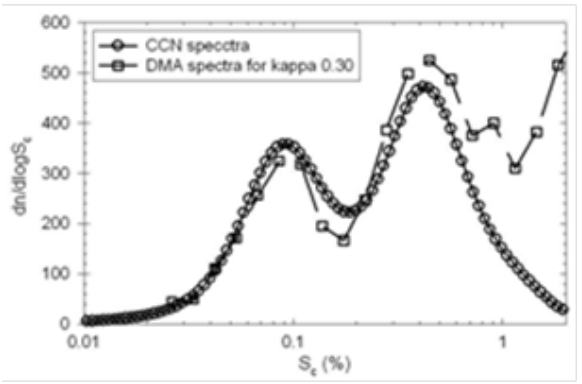

Figure 1: CCN and DMA spectra under California coastal stratus cloud deck.